Teachers Notes

Red Planet Mars

Worksheet answers

Task 1:

The surface of Mars appears at first glance to be a dry and desolate surface with little to see. Further examination however reveals that the surface has many marks, patterns and features that point to a very different history on the planet. The diagram below shows a number of features that appear on the red planet.

• Volcanoes - There are four main volcanoes on the Martian surface. The largest, Olympus Mons, is a towering volcano measuring approximately 24 kilometres in height. That is three times the height of Mount Everest. Three other volcanoes are located to the east of Olympus Mons, names of three volcanoes. What do ancient volcanoes tell us about the history of Mars? Obviously it was geologically active, like our own planet, with eruptions and lava flows over the surface. The volcanoes appear not to have been active for 3 billion years, so they're unlikely to resume in the future.

• Ancient River Channels - Images from Mariner 9, Viking 1 and 2 and more recently the Mars Global Surveyor, have shown dry river channels where water must of once flowed. Where has the water gone? Water cannot stay in a liquid form on the surface because of the low atmospheric pressure (it must be ice or gas). Many scientists believe that vast quantities of ice water exist below the surface. The goal of the Mars Polar Lander is to look for sub-surface ice, by digging under the surface.

• Craters - like many terrestrial objects (rocky) in the solar system, Mars has many craters. Most of these craters are in the Southern Hemisphere. Craters are useful to scientists examining mineral composition through remote sensing. Older material under the surface is thrown out in the impact. Why does the Northern Hemisphere have fewer craters? It appears that water, mud and lava have smoothed the surface. Therefore the north was probably more active than the south.

• Canyons - Further east of the Tharsis Mons volcanoes on the Martian equator is the Valles Marineres. This huge canyon would stretch across Australia is 5 kilometres deep in parts. What is different about this canyon is that is likely to have formed by a huge impact on the opposite side of the planet. Close up images from Mars Global Surveyor show ancient river channels also winding through the canyon basin.

• Polar Caps - The north and south polar regions of the planet is covered in layers of ice and dry ice (solid carbon dioxide). The South Pole is much larger and has a higher percentage of dry ice. There is so much carbon dioxide frozen in the south pole that the atmospheric pressure increases by 25% during summer, when the polar ice thaws.
• Sand Dunes - Although not visible on the globe, recent images have shown sand dunes on the Martian Surface. These dunes move much slower than those on Earth due to the thinner atmosphere, which has trouble pushing the sand and dust around.

Task 2:

Sojourner was the first rover to be used on another planet. Previously the Russians had used the Lunakhod rovers on the surface of the Moon. A rover has a number of advantages over a stationary lander.
• A rover can examine many more samples. Sojourner traveled over 80 metres sampling a dozen different sites during its 87-day journey.
• They can provide a unique view of the landing site. The camera on board the lander, although able to rotate 360°, was stuck in the one location. The rover was able to see the backside of rocks, image close up to samples and even look back at it's landing site.
Of course there are many challenges to building a rover that will last on another planet. On Mars the temperature was too cold to use rubber
It is virtually impossible to use lubricants in the axle and bearing of the wheels as these would freeze.
Computers on board the rover must be rugged enough to not only withstand the freezing temperatures, but also the extreme levels of ultraviolet radiation. Mars's thin atmosphere lacks an ozone layer and consequently the surface is bathed in ultraviolet light. Normal computers would be destroyed in minutes.
The distance between Mars and Earth can vary between 50 and 500 million kilometres. This means that controlling a rover remotely is near impossible. The signals travelling between these planets take at least ten minutes on a one way trip. Therefore the rover must be equipped with some form of 'artificial intelligence' to help it drive without any problems.

Task 3:

The image above is a portion of a full-colour panorama of the Mars Pathfinder landing site. This portion covers about one quarter of the surrounding ‘marscape’ of Ares Vallis (Mars Valley). Visible next to the rock named Yogi is the rover Sojourner. She has backed up to Yogi and has placed the Alpha Proton X-ray Spectrometer instrument against the rock in order to determine its elemental composition. Yogi is approximately 6.5 metres from the Mars Pathfinder lander and stands about 1 metre high. Sojourner is 30 cm tall.

In the lower left corner of the image is the ramp that Sojourner used to roll off the lander petal and onto the Martian soil. Sojourner’s tracks across the soil are plainly visible and are darker than the undisturbed soil. The dark streaks on the soil above the airbags were caused when the airbags were reeled in during the first hours after landing on 4 July 1997. In two locations, near the end of the ramp and on the way to Yogi, disturbed dust shows where Sojourner made pivoting turns.

A dusting of very fine-grained material is also seen on a number of rocks in the view. Dust has gathered to the left of Barnacle Bill, the pitted football-shaped and -sized rock above the end of the ramp. The wind on Mars can carry only very lightweight and fine-grained dust — although the wind can blow at speeds of hundreds of kilometres per hour, it does not have enough force because of the thin atmosphere. Some of the talcum powder-like dust can be seen on the rover’s wheels, and suspended dust particles give the sky its colour.

At one time in Mars’ past, a large amount of water rushed across this area. The direction of flow was to the north, which is toward the upper right corner in this picture. The floodwaters cut a series of gullies in the plain. The gullies line up in the direction of the water flow. A trek across this ‘marscape’ toward the horizon would carry you up and down a series of hills and valleys.

On the horizon is the rock known as the Couch. Most rocks are informally named for their appearance by scientists to make them easy to identify during team meetings and public discussions. The Couch is more than 150 metres away. The Imager for Mars Pathfinder stereo

camera, which took this image, allows team members to measure distances to about 150 metres. But they must estimate distances beyond that — unless a feature can be identified from images taken by one or both Viking orbiting spacecraft.
Viking Orbiters 1 and 2 photographed the planet between July 1976 and August 1980. Orbital views of the Mars Pathfinder landing region show two regions now known as the Twin Peaks. In the upper left corner of this view is the North Peak. It is an estimated 0.86 kilometres away from the lander.
Many people have suggested that the landing site is similar to the Simpson Desert in Australia or Death Valley in the United States
This image and additional information about the Mars Pathfinder mission can be found on the Internet at: *http://mars.jpl.nasa.gov/*

Task 4:

Colour of the Soil
Earth: Brown, Yellow or Red Mars: Red and Yellow

The soil of Mars is red because of its high Iron Oxide (Rust) content. The soil is also highly corrosive and lacks a number of nutrients (e.g. Nitrates) that allow plants to grow in it.

Task 5:

Essential items in order of importance.

Oxygen: The atmosphere of Mars is mainly Carbon Dioxide. There is little to no Oxygen in the air and therefore this would be the most essential item for surviving.

Suit: Mars' lack of an ozone layer means the planet is bath in ultraviolet light. Protective clothing is needed to shield you for the intense radiation. The lack of air pressure also means that your suit must be pressurised, otherwise you may explode.

Food: There is no food or lifeforms on the surface of the planet (as far as we know).

Water: Although there may be water under the surface of Mars, it's not in a form that we can readily drink. It's probably a good bet that you'll need more than you can extract, because the fine dust in the air will make your throat very dry.

Radio: If you get lost on the surface of the planet you may have a slight problem. Mars has a very weak magnetic field. Actually it has a number of weak magnetic fields. This makes a compass useless on the planet's surface. A map and or radio to communicate back to base would be best.

Other items that you may use:

Task 6:

There are many stories behind how each of the patches for US missions. We've included in your pack a list of some of the patches. What items would you include on a patch for the first human Mars expedition? This is a list that we are the Communication Complex came up with:

Previous Patches

MERCURY 4 - LIBERTY BELL

Gus Grissom chose the name Liberty Bell because the capsule was shaped like a bell and because it carried stirring American connotations so important during the early days of the American space program.

"Then one of the engineers got the bright idea that we ought to dress Liberty Bell up by painting a crack on it, just like the crack on the real one. Ever since my flight, which ended up with the capsule sinking to the bottom of the Atlantic, there has been a joke around the Cape that that was the last capsule we would ever launch with a crack in it. "-Gus Grissom

APOLLO 8

“The design of the Apollo 8 patch was quite unique. We were going to...make a circumlunar flight around the moon. On the way back to Houston the next evening, Frank was flying the aeroplane, and since I had nothing to do I sort of sketched out what I thought would be an appropriate patch. The shape of the patch symbolises the Apollo spacecraft. The figure 8 signifies Apollo 8 and also the flight path we took to the moon and back. After I returned to Houston I gave my sketches to the NASA artist who made the final drawing.” -Jim Lovell

APOLLO 11

'It needed something simple, yet something that unmistakably said peaceful lunar landing by the United States. Jim Lovell, Neil's back up, introduced an American eagle into the conversation. I added a small earth in the background and drew the sunshine coming from the wrong direction, so that to this day our official insignia shows the Earth over the lunar horizon like when it should really look like . Jim Lovell and I both agreed that the Eagle alone really didn't convey the entire message we wanted. The Americans were about to land, but so what? Tom Wilson, our simulator instructor, overheard us and piped up, why not an olive branch as a symbol of our peaceful expedition?” - Michael Collins.

STS-26

The predominant themes of this patch are: a new beginning (sunrise), a safe mission (stylized launch and plume), the building upon the traditional strengths of NASA (the red NASA vector), and a remembrance of the seven astronauts who died aboard Challenger (the seven-starred Big Dipper.

STS-49

The ship depicted on the patch is HMS Endeavour, the sailing vessel that Captain Cook commended on his first scientific expedition to the South Pacific. The flags flying high on Endeavour’s masts wear the colours of the two schools that won the nationwide contest when Endeavour was chosen as the name of NASA’s newest Space Shuttle: Senatobia (Mississippi) and Tallulah Falls (Georgia).

Mars Surveyor ‘98

"The central idea of this insignia is shown in the globe of Mars, which is split down the middle to depict what Mars may have looked like in the past (on the left) and what it looks like today (on the right)," said Seal, a systems engineer in the Mission Design Group at NASA's Jet Propulsion Laboratory, Pasadena, CA. "This illustrates the science objectives of the mission, which are to study the history of Mars' climate and the behavior of related volatiles, such as water vapor and ground ice."